

8.6 Soil resistances for designing foundation

As discussed earlier, the foundations of towers are subjected to three types of loads viz., the downward trust (compression), the uplift (tension) and the side trust (horizontal shear). The soil resistances available for transferring the above forces to earth are described below.

Uplift resistance

The soil surrounding a tower foundation has to resist a considerable amount of upward force (tension). In fact, in the case of self-supporting towers, the available uplift resistance of the soil becomes the most decisive factor for selection for a particular location.

It is generally considered that the resistance to uplift is provided by the shear strength of the surrounding soil and the weight of the foundation. Various empirical relationships linking ultimate uplift capacity of foundation to the physical properties of soil like angle of internal friction (ϕ) and cohesion (C) as well as the dimensions and depth of the footing have been proposed on the basis of experimental results. However, the angle of earth frustum is considered for calculating the uplift resistance of soil. Typical value of angle of earth frustum; are given in table of annexure for guidance the angle of earth frustum is taken as $2/3$ of the angle of internal friction or the value given in the table whichever is smaller for the type of soil under consideration. The uplift resistance is estimated by computing the weight of the earth contained in an inverted frustum of cone whose sides make an angle (θ) with the vertical equal to the angle of earth frustum.

It should, however, be noted that effective uplift resistance, apart from being a function of the properties of soil like angle of internal friction (ϕ) and cohesion (C) is greatly affected by the degree of compaction and the ground water table. When the backfill is under consolidated with non-cohesive material, the effective uplift resistance will be greatly reduced. In case of foundation under water table, the buoyant weights of concrete and backfill are only considered to be effective. The uplift resistance of footing with under cut projections within undisturbed soils in firm non-cohesive soils and fissured/soft rock generally is larger than that of conventional footings.

Lateral soil resistance

In foundation design of towers, the side thrusts on the foundation are considered to be resisted by the passive earth pressures mobilized the adjoining soils due to rotation of the footing. Passive pressure/resistance of soil is calculated based on Rankine's formula for frictional soils and unconfirmed compressive strength for cohesive soils.

Bearing capacity

The downward compressive loads acting on the foundation including moments due to horizontal shears and / or eccentricities, where existing, are transferred from foundation to earth through bearing capacity of soil. The limiting bearing capacity of soil is the maximum downward intensity of load which the soil can resist without shear failure or excessive settlement.